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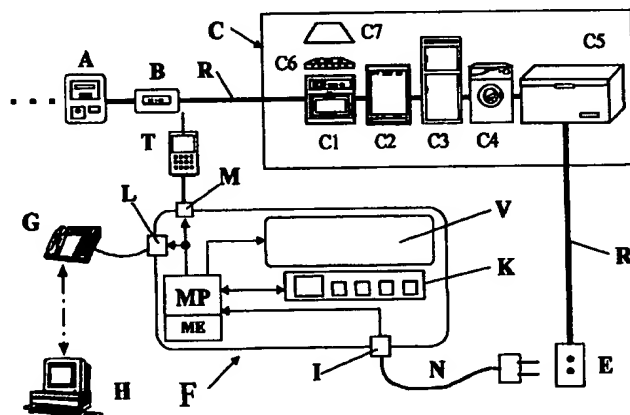
(57) Abstract

A system for the monitoring and/or the remote technical service, prior to a local maintenance operation, of a plurality of electric users, in particular household appliances (C), belonging to a same household environment, comprising a specific monitoring device (F) capable of collecting through a local network (R) connected with the users (C) (in particular the same power supply network), and storing in a suitable nonvolatile but updatable electronic memory (such as FLASH or EEPROM memory), functional, diagnostic and statistical information generated and made available on said local network (R) by said household users (C). The monitoring device (F) comprises proper means to receive, manage and make explicit said information received from said household users (C), where said information may be made explicit at a local level, directly to the utilizer, and/or at a remote level within the household environment (such as for instance to a personal computer eventually available in such an environment and properly interfaced with said local network) and/or finally at a remote level, i.e. outside the household environment, to a specific center for the technical service and/or preventive maintenance prior to a local operation for said plurality of household users.

SYSTEM, DEVICE AND METHOD FOR MONITORING A PLURALITY OF ELECTRIC USERS, PARTICULARLY HOUSEHOLD APPLIANCES

DESCRIPTION

The present invention concerns a system, a device and a method thereof for monitoring a plurality of electric users, in particular household appliances connected in a network and belonging to a same household environment.

As it is known, *home automation*, i.e. exploiting electronic technology in the household

5   environment, whose aim is to cut down managing costs of the various users and develop new comfort, is getting more and more in use. This is substantially due to the following reasons:

- an increasing spreading of consumer electronics devices, such as videorecorders, HI-FI systems, satellite receiver systems, safety and theft-safe systems, personal computers,

10   mobile telephones, etc.

- the recent significant developments related to the control systems for household appliances, which are based on the use of microcontrollers and new sensors, and are able to dialog with the external world;.

- a progressive affirmation of communication *bus standards*, i.e. ruling systems defining

15   the procedures for information exchange between the various household users and the physical means such information are transmitted onto.

With reference to the latter point, it is particularly important to know that the communication means establishing itself as a standard in the household environment is the so-called *power line*, i.e. the power supply network whereto information can be sent in the

20   form of amplitude or frequency modulated small signals. The use of such a means, in fact, allows connection of household users to the network without the need of introducing new or special wiring systems.

As a result, new opportunities based right on the use of the *power line* are created, which relate to the rationalization themes of energy consumption in the home and improved

management of information associated with the various household users. In this frame, several proposals are already known, which are based on the use of control and supervision systems or devices for the household users, all of them characterized in that:

-   they perform automatic activity, even if against an appropriate operation by the utilizer

5   or customer for their starting configuration;

-   they are classed at a hierarchical higher level compared to the household users level, i.e. developing an active control, with a *master* role, over them.

A fully alternative solution to such a "centralized" control and supervision approach of household users is disclosed in the European Patent Application EP-A-0 727 668, filed by

10   the same Applicant hereto.

Such a document describes a set of household appliances capable of constantly receiving information concerning the total power absorption of all household users (household appliances, illumination system, air conditioning system, etc.), concerning the maximum usable power (power supply contract), the current time (clock function) and the likely

15   different electricity cost according to variable use hours rates.

Such information are supplied by a special external sensor, which may be the same electric meter developed to that purpose, or an alternative device specifically provided. The means whereto such information are flowing may be of different type; however, the *power line* is a preferable one, i.e. the electric network itself, since there is no need for additional wiring.

20   The set of household appliances described in EP-A-0 727 668, each one equipped with a suitable electronic control system and adequate interfacing means to the network, is able to limit its own electric power consumption "spontaneously" and automatically, so as to maintain the total consumption of the whole household environment constantly below the limit established in the power supply agreement, requiring neither an external centralized

25   supervision system nor any operation by the utilizer.

The present invention is based on the acknowledgment of the fact that in such a system of "smart" household appliances connected in a network, it would be useful for the utilizer and/or anybody charged with their maintenance to be informed of the operation status of the

various household appliances, as well as of their "historical" events.

Therefore, it is the main aim of the present invention to provide a monitoring system allowing the utilizer to verify from one home site or household environment site alone (preferably any site) the operation status of all "smart" appliances connected to the network

5   and capable of communicating with the monitoring system itself.

A further significant aim of the present invention is to provide a monitoring system, which is able to acquire and retain in a non-volatile but updatable memory diagnostic and statistical data generated by each individual "smart" appliance connected in the network and adequately equipped to that purpose.

10   A further aim of the invention is to provide a monitoring system as described above, which allows transmission of the data stored therein to a proper external location, in order to allow a remote customer service, even a "preventive" one, for the relevant household appliances.

Such aims and many others are obtained through a system, a device and a method for monitoring a plurality of electric users, in particular household appliances connected in a

15   network, which belong to one same household environment, as described in the annexed claims which form an integral part of the present description.

Further aims, features and advantages of the present invention will become apparent from the following detailed description and the annexed drawing, which are supplied by way of non limiting example, wherein the Fig. 1 shows schematically an embodiment of the system

20   according to the present invention as viewed in the context of a household environment.

In Fig. 1, reference A indicates a power meter, which may either be a standard type, i.e. only apt to measure the electric power absorbed in a household environment and indicate the total power consumption, or an advanced type, i.e. comprising a remote managing system and variable use hours cost rates.

25   Reference B indicates an auxiliary measuring device, located downstream the power meter A, which is intended to adequately convey various information on the network R of the household environment, eventually including also the information supplied by the power meter itself. The measuring device B may advantageously also perform the function of

"screening" the power meter A from the communication signals circulating in the network R

of the household environment, through a suitable filter known as such.

The measuring device B, in particular, has suitable means to supply on the network R with

those information the power meter A is unable to supply, which are required for the

5   rationalization of the electricity consumption, according to the procedures indicated in the

above mentioned patent application EP-A-0 727 668. Such information supplied by the

device B vary according to the type of power meter available in the household environment;

merely by way of example, the data supplied for the two types of power meters as indicated

above, can be as follows:

10   a) standard power meter:

       - value of the power supply contract;

       - measure of the current absorbed instant by instant by the set of household users;

       - current time;

       - likely variable use hours and relevant cost.

15   b) advanced power meter (with remote management):

       - measure of the current absorbed instant by instant by the set of household users;

       - current time.

As it can be noticed, the network R also represents the household communication network

through which the electric users, duly equipped to that purpose, are able to exchange

20   information, as further detailed in the following.

Reference C indicates as a whole a set of household appliances belonging to the same

household environment controlled by the power meter A, each appliance having a suitable

interface for its connection to the conveyed-waves network R; in particular Cl, C2, C3, C4,

CS, C76 and C7 indicate an electric oven, a dishwasher, a refrigerator, a laundry washer, a

25   freezer, a cooking hob and an exhaust hood, respectively.

It will be appreciated that other household users, differing from the ones usually indicated

with the term "household appliances", may also belong to the set C, provided they have a

special interface for their connection to the conveyed-waves network and their own "smart"

control system for a rationalized power consumption as described in EP-A-0 727 668.

The elements mentioned so far represent a basic set of integrated household appliances, which are able to rationalize their power consumption according to the procedures already mentioned in the above European patent application (to which reference can be made for

5   further details); the purpose of this is to avoid of exceeding the value of the maximum usable power (power supply contract) and the consequent possible electric black-outs, caused by the switching in of a thermal limiting device, usually provided inside every household power meter.

Reference E indicates a generic standard current socket, through which a device F can

10   receive power supply and consequently information in the form of conveyed waves from the set of household appliances C, or from other users connected to the network R.

Said device F, which is equipped with its own supply cable N for connection to the network R, is provided for the local monitoring and the remote servicing of the household appliances C connected to the network, and represents the main element of the present invention; the

15   device F is preferably equipped with a suitable buffer battery to ensure operation also in case of an electric black-out of the network R.

Reference G indicates a telephone, whose line is apt to be used for the remote transmission to a *Bulletin Board Service* (BSS) of a center for the customer service or preventive maintenance of the household appliances or users C; said remote customer service and

20   preventive maintenance center is represented schematically by a personal computer, indicated with H.

The device F has suitable means to collect various information (through the network R, by means of the cable N) from the household appliances C for their managing their storage on suitable memory means and to express them, or make them explicit, according to various

25   procedures.

Such functions are performed by the device F with means already known per se, such as a conveniently programmed microcontroller MP, which is provided with a suitable conveyed-waves interface I and nonvolatile updatable electronic memory means ME (for example a

FLASH or EEPROM memory).

Communication from the users C to the device F, which takes place through the network R itself, is based, as mentioned above, on the well-known technique of conveyed waves, with FSK modulation *(Frequency Shift Keying)* or AFK modulation *(Amplitude Shift Keying)*;

5   the flow of information from the various users C to the device F is ruled by suitable standard protocols, which are able to warrant a non-conflictual sharing of the same transmission means R (i.e. the electric network or power line) between the household users C in relationship with the device F and other likely users also available in the same household environment.

10 As said above, the information that the device F is able to collect, store and make explicit are generated by the household appliances C, which are equipped with adequate control systems to this purpose.

In particular, each of said control systems has interfacing means with the communication bus consisting of the network R, and is programmed to send onto said bus, through said

15 interfacing means, information related to the operating conditions of the household appliance. Said information are of various type and for the purposes of the present invention they can be distinguished into *functional, diagnostic* and *statistical* information.

Functional information concern the current operating mode of each household user capable of communicating with the device F, where such a mode is expressed through the value of a

20 set of parameters and/or physical quantities characterizing the operation status of each user. Merely by way of a non limiting example, in the instance of the refrigerator C3 such functional information may refer to the temperature value selected by the utilizer, the temperature value of the various compartments, the compressor status (ON or OFF), the opening or closing status of the doors, and so on.

25 *Diagnostic* information concern the operation quality of each household user capable of communicating with the device F, i.e. revealing the *efficiency status* of certain components related to each household user C; such an operation quality is revealed through the value of a set of diagnostic parameters, typical for each user.

Merely by way of a non limiting example, in the instance of the freezer C5 diagnostic information may refer to the number of times the storage temperature has reached less cold values than - 18°C, the number of blackouts of the network R, the operation status of the temperature sensors, a likely extended open-door status, the number of switch-in times of

5 the compressor overload-protector, the operation ratio or *duty cycle* (i.e. ON time of the compressor referred to the total cycle time = ON time + OFF time), etc.

Statistical information concern on the contrary the operation statistical data of every household user capable of communicating with the device F; such operation statistical data practically form the "history" of each user C, from a standpoint of the operations and/or

10 functions performed and from a standpoint of use procedures by the utilizer, thus supplying and reveals on the *wear status* of both the mechanical and electric components.

Merely by way of a non limiting example, in the instance of the laundry washer C4 statistical information may refer to the total number and/or type of wash cycles selected by the utilizer, the number of washes associated with the different kinds of fabric, the quantity of

15 clothes washed in average for each kind of fabric, the changes made by the utilizer to the temperature value (both to increase and decrease), the changes made by the utilizer to the spin speed value, the water hardness value, the number of rinses performed in average, etc.

As mentioned, the above *functional, diagnostic and statistical* information are generated by the individual household appliances C, which are equipped with suitable sensors already

20 known as such and an advanced control system.

In this frame, it should be appreciated that the microcontroller-based control system of each household appliance C is programmed for the control of all programs and functions which can be performed by the appliance itself; therefore, the control system has a complete knowledge of the appliance operation status and is perfectly able to know, instant by

25 instant, such as in the instance of a refrigerator C3, whether the relevant electric loads (compressor, defrost heater, air circulation fan, lamp in the refrigerating or freezing compartment, etc.) are activated.

Thus, according to the above, it is clear how the control system of each household

appliance C is able to generate and send to the device F information of different nature, such as related to the program or function activated by the utilizer, to the advancement step of said program or function, to the instructions inputted by the utilizer, to the timing associated with activation and deactivation of the individual electric loads, to likely

5   improper behaviours of certain components, etc.

Always in this frame, the device F can be supplied with information obtained through internal sensors of the individual appliances C, such as the water hardness degree from the water network (for example measured by a suitable sensor available in the dishwasher C1), or the type and quantity of clothes being washed (values that the control system of the

10   laundry washer C4 is able to obtain with techniques already known), the room temperature (for example if the refrigerator C3 is equipped with a sensor to measure such a parameter).

According to a significant feature of the present invention, further information are also encoded in the nonvolatile memory of each control system of the household appliances C, which refer to the typical consumption features of various electric loads (pumps, solenoid

15   valves, motors, heaters, etc.) of the appliance itself, under their various employment conditions; in other words, the control system of each appliance C is aware of the electric power absorbed by its various associated electric and electronic components; as a result, it is able to calculate, instant by instant, the total power consumption of the household appliance under control.

20   According to the present invention, the result of such a calculation of the power consumption of each household appliance C (which can be used by the set of individual control systems to rationalize electric power consumption and avoid outweighing the maximum usable or contractual power value) can be used for further purposes.

In particular, such consumption information can be efficiently displayed for the utilizer in

25   the frame of the above *functional* information (such as in view of an energy saving "consciousness"), or stored in suitable memory means as part of the above *statistical* and/or *diagnostic* information.

Moreover, the control system of each household appliance C is programmed according to

known techniques to periodically store at least the *diagnostic* and the *functional* information in its own memory means, and to update their contents in the time.

Similarly, the microcontroller MP of the device F is programmed to periodically receive through the network R the information generated and/or stored by the control systems of each appliance, in order to store and update them in its own memory means ME. From the above it will be appreciated how the control system of each household appliance C is able to send said *functional*, *diagnostic* and *statistical* information to the device F and how the latter is able to receive them, and/or store them, and/or update them in its own memory ME.

The microcontroller MP of the device F is also programmed to make explicit, through proper means, the information the various appliances C makes available on the network R and/or stored in the memory means ME, with the following modes:

1) at local level, i.e. directly to the utilizer, by means of an adequate display V manufactured according to a known technology (liquid crystals, fluorescent tubes, LED diodes, electroluminescent panels, etc.), whose complexity level is adequate for the quantity and quality of the information to be displayed;

2) at remote level, directed to a customer service and preventive maintenance center H for said plurality of household users C.

In order to allow interaction with the utilizer, the device F also has proper input means, such as a keyboard K, through which it is possible to select the type of information to be displayed at local level (i.e. on the display V of the device F), as well as activate a remote transmission system to the center H.

To allow said remote transmission of the collected information, the device F has inside a standard modem, not shown in the figure, which is connected to the home telephone line through a proper standard connection system, shown schematically with L.

A further instrument to transmit the collected information at the remote level may consist of a telephone, indicated with T in Fig. 1, of the standard cordless type (DECT, or other digital or analog type) or a standard cellular or mobile type (GSM or other digital or analog type), which can be interfaced with the monitoring device F itself through a proper standard

connection system M, delivered with the latter.

It should be appreciated that, according to the present invention, the likely transmission of information through the monitoring device F to the remote site H is performed in conformity with the laws in force in the various countries protecting citizens' *privacy*;

5   therefore, in other words, such a transmission occurs under the full control of the utilizer, who can decide what type of information has to be sent, the transmission procedure and the relevant frequency.

As to the remote site H, this can be represented as said above by a customer service center for the household users C associated with the device F.

10   This center is provided to perform a customer service and preventive maintenance activity for the household appliances C, as planned by a proper agreement entered with the utilizer. Such a customer service activity is based on the *diagnostic* data sent by the utilizer to the center through the device F (as said, *diagnostic* data are generated by the household appliances C, stored in their memory means, transferred periodically to the memory means

15   ME of the device F and then transmitted by the latter to the center H). Preventive maintenance activity, beside said diagnostic data, is also and above all based on the *statistical* data, which are sent to the service center through the device F (as said, also *statistical* data are generated by the household appliances C, stored in their memory means, periodically transferred to the memory means ME of the device F, and then transmitted by

20   the latter to the center H).

Concerning the transmission procedure of the information to said customer service and preventive maintenance center, this can be a manual type, i.e. handled directly by the utilizer, or automatic (periodic transmission of information governed by a specific customer service agreement); in both instances, advantageously for the utilizer, information

25   transmission can be made through a toll-free call to a special number of the center itself.

From a practical standpoint the device F operates as follows.

Functional information, i.e. concerning the current operating procedure of every household appliance C are generated by their own control systems and inputted in the network R for

the benefit of the device F (as previously mentioned, transmission of information from the various users C to the device F is controlled by appropriate standard protocols), and the device F, duly programmed for that specific purpose, will make said information explicit on its own display V.

5   The display modes on the display V may be of various type. For instance, it can be thought of a sequential display of the operation parameters of all active household appliances C; thus, the display V will first show for example the parameters related to the oven C1, followed by the parameters related to the dishwasher C2, then the ones related to the refrigerator C3. and so on.

10   A further possibility is to provide a display "on request" of the parameters of the appliance C to be monitored from time to time; in this instance, the appliance involved is selected by pressing a special push-button on the keyboard K, and the microcontroller MP will enable the display V to show only the operational parameters of the selected appliance.

In a possible embodiment of the present invention, the control systems of the household

15   appliances C make available on the network R all functional information they are able to generate; in this frame, the device F has eventually the function of operating as a "filter", for displaying only the information selected by the utilizer through the keyboard K. However, nothing hinders the possibility of programming the device F to "inquire" a specific appliance C with a query placed by the utilizer through the keyboard K.

20   It is pointed out that the microcontroller MP can favorably be programmed also to draw automatically the attention of the utilizer (for example through a flashing of the display V, or the activation of an acoustic alarm eventually available in the device F), should any of the household appliances C introduce in the network R information related to an improper operating condition (such as jammed impellers in the dishwasher C2, extended open door

25   condition in the refrigerator C3, accidental blow-off of a burner on the hob C6, all conditions detectable by sensing means already known as such).

However, it is clear, that an adequate presetting of the microcontroller MP through programming techniques already known allows implementation of various display

possibilities on the display V, and the selection through the keyboard K of the type and complexity level of the functional information to be made available (save that these are generated in an automatic and autonomous way by the control systems of the appliances C).

It has also to be remembered that, for the display purposes on the display V, temporary

5   storage of the functional information can be provided, in the memory means ME, if so required.

Diagnostic information, i.e. concerning the operation quality of each household appliance C, are generated, stored and updated with time by the relevant control systems. Such information are then periodically let in the network R, always through the control systems

10   of the individual appliances C, for their transfer to a special area of the memory means ME of the device F.

Also transmission of these data from the control system of each appliance C to the microcontroller MP and from the latter to the memory means ME occurs automatically, in the sense that the same control systems of the appliances C are programmed to perform a

15   data transfer at periodic terms (such as for example once a day), either spontaneously or upon request from the device F.

Diagnostic information stored in the memory means ME are then transferred, by means of the telephone G or T, through the microcontroller MP to the service center H.

The microcontroller MP can be programmed to perform such a transmission at remote level

20   in an automatic mode, at periodic terms, and eventually also following a suitable utilizer's instruction inputted through the keyboard K.

Also *statistical* information, i.e. the data forming the "history" of each user, based on their operations and/or functions performed as well as on usage procedures by the utilizer, are generated, stored and updated with time by their relevant control systems. As for the

25   instance of *diagnostic* information, also statistical information are periodically admitted to the network R, to be then transferred to a special memory means ME of the device F.

Also the transmission of these data from the control system of each appliance C to the microcontroller MP and from the latter to the memory means ME is automatic, in the sense

that the control systems of the appliances C are programmed to perform data transfer at periodic terms, either spontaneously or upon request of the device F.

Also in this instance, *statistical* information stored in the memory means ME are then transferred through the microcontroller MP, by means of the telephone G or T, to the

5   service center H; the microcontroller MP can be programmed to perform such transmission at remote level in an automatic mode, at regular intervals, and eventually following a suitable utilizer's instruction inputted through the keyboard K.

Similarly to the above concerning *diagnostic* information, transmission of statistical data is performed under the utilizer's full control, in conformity to the laws in force in the various

10   countries protecting citizens' *privacy*.

As to the physical realization of the monitoring device F, this can freely be either portable or transportable or fixed type.

In the first instance, the device F will be apt to be taken to any place of the home environment where a power socket E is available, i.e. it can be efficiently used by any

15   individuals compelled to remain for longer time in determined areas of the home environment, due to deambulation problems (such as in the instance of an individual with temporary handicap).

In the instance of a fixed device F, it may be associated with a set of users pertaining to a homogeneous context of the home environment, as for instance the kitchen. In this case, the

20   device F can be integrated in the furniture (let us think for instance of the so-called *sectional kitchens*, i.e. having a modular structure) and represent a typical element of said environment to be adapted to the style of the kitchen itself and relevant trade-mark associated with the supplier of the kitchen furniture.

Thus, the device F can take most variable configurations: either as in-sight monitoring board

25   or hidden inside a cabinet door, as a telephone stand, as a wall clock with an associated display showing the status of the various household appliances C, as a lamp comprised element or other knick-knack, etc.

Back to the typical kitchen environment, the set of the users C may consist of the totality or

a part of the following household appliances: gas or electric oven C1 (including the microwave oven), dishwasher C2, refrigerator C3, laundry washer C4, freezer C5, gas or electric hob (including the induction one) C6, exhaust hood C7, electric or gas boiler.

At least some of these appliances can be of the built-in type, i.e. incorporated inside cabinets

5   representing the furniture of the kitchen environment itself. In this specific case, since the appliances are incorporated inside the cabinets, the physical means for the transmission of information to the device F could be, as a possible low-cost alternative for the electric network R itself, a simple duplex telephone cable type, or other cable with two or more wires, characterized by a *multi-point* serial communication protocol, i.e. wherein a certain

10   number of appliances are connected to the same serial line, each one identified by a well determined address. Such a solution should be considered specific for a modular kitchen and is perfectly compatible with the idea of not requesting the final utilizer for any additional wiring besides the pre-existing electric network; in such a case, in fact, a specific wiring for the built-in appliances C would be delivered by the same furniture supplier as an integral

15   optional part of the modular kitchen itself.

As previously mentioned, a further possible function to be associated with the device F is to contribute to the rationalization of the power consumption of the household users according to the solution described in the above European patent application EP-A-0 727 668.

In such an instance, the monitoring device F will be programmed to receive from one source

20   alone, through the same network R, and display the total absorption of electric power of the whole household environment, as well as the value of the power supply contract, i.e. the maximum electric power usable according to said contract.

Such an information source on the total absorption of electric power of the whole household environment and on the value of the power supply agreement can be obtained as

25   said above (and as described in the above patent application EP-A-0 727 668), through a suitable power meter or the appropriate additional measuring device B located downstream the power meter itself.

Eventually, the device F may also be used to make explicit on the display V either

automatically or on utilizer's request the information related to the instantaneous consumption of each individual appliance, which the relevant control system is able to calculate as previously described.

The likely function of the device F for the purposes of rationalizing electric consumption is particularly interesting in the instance of a modular kitchen with built-in household appliances C connected to a serial network, as described above.

In such an event, in fact, the device F may be favorably programmed, besides performing its own monitoring functions, to constantly inform the built-in household appliances C of the kitchen environment - provided they are connected through a serial network with electric cable or duplex telephone type cable (if not equipped to dialog directly with the power meter A and/or the measuring device B through the electric network R itself) - of the available value of the residual power, obtained as the difference between the value of the power supply contract and the total power absorbed; in other words, in such an application the device F would be an interface itself between the conveyed-waves network R and the network provided for the built-in household appliances.

On the contrary, the electronic control systems, associated with the monitoring device F, will be so programmed to self-limit the absorption of the electric power of the respective built-in household appliances C based on the value of the residual power and according to appropriate priority criteria (contained in the memory of the control system itself of each individual household appliance), with the aim to ensure that the value of the total power absorbed by the whole home environment will never exceed the value of the power supply contract.

As a result, the system consisting of the above device F and of the set of built-in household appliances connected through a dedicated network, each one of them equipped with the above appropriate control system, will be able to constantly avoid in a fully automatic mode, the operation of the thermal limiting device associated with the power meter, which switches in anytime the power absorption of the whole home environment exceeds the value of the power supply contract; thus, the utilizer is warranted a new performance of a

modular kitchen, represented by the suppression of black-outs due to accidental power

overabsorptions and by the consequent saving on the electric bill (since the cost of the

absorbed power over the limit value of the power supply agreement will tend to be always

higher compared to the cost of the electricity absorbed under normal conditions).

5   Obviously, such a performance of the device F is not necessarily limited to the instance of a

modular kitchen, but can also be provided for all household appliances connected to the

network R of a home environment, provided they conform to EP-A-0 727 668.

The features of the present invention are clear from the above description.

In particular, a system and a monitoring method have been described, based on the use of a

10   suitable device (F) capable of collecting through a suitable communication network R

(preferably consisting of the electric supply network itself) and storing on an appropriate

nonvolatile electronic memory (ME) both the "functional", "diagnostic" and "statistical"

information generated by one or more household users (C), each one of them being

equipped with a control system capable of generating such information and supply them

15   adequately through said network (R) to said device (F).

Said device (F) according to the present invention also contains appropriate means (V, L,

M) for making explicit such information, at local level directly to the utilizer and/or at

remote level to a special service and preventive maintenance center H.

Also the advantages of the present invention are clear from the above description.

20   According to the invention, the utilizer or anybody in charge of the maintenance of the

household appliances has the possibility of being informed of their operating status, wear

conditions and "historical" events.

Thus, the utilizer is able to verify from one place alone in the home the operating status of

all household appliances connected to a same network; equally, information of various kind

25   related to the household appliances may be transmitted to an appropriate external place, so

as to allow for an efficient remote servicing, even of a "preventive" type, of the household

appliances themselves, or for simplify the local maintenance operation.

Another important advantage of the invention is the provision of an instrument apt to

acquire and retain in a nonvolatile memory all diagnostic and statistical data generated day by day by each individual appliance connected to the network, and properly equipped to such purpose, where said data can prove useful for various events (maintenance, repair, suggestion for use, and so on).

5   It is obvious that many changes are possible for the man skilled in the art to the system, the device and the method for monitoring a plurality of electric users described above by way of example, without departing from the novelty spirit of the inventive idea..

For example, in an especially advantageous embodiment of the invention, the connection of the device F to the system of the appliances C may be of the self-installing type, commonly

10   known with the name of *plug & play*, i.e. a type where no programming operation of the system is required, not even during installation.

Another possible variant of the system described above is to provide the connection to the network R of a personal computer, having an appropriate conveyed-waves interface and appropriate software, which allows the utilizer to inquire the device F.

15   In such an instance, then, the device F would be apt to reveal *functional, diagnostic* and *statistical* information at remote level, though always remaining within the home environment, i.e. on the personal computer monitor, as requested from time to time by the utilizer through the above software.

Similarly, if the mentioned personal computer is equipped with its own modem and

20   supported by the above software on issue, it could be used by the utilizer to perform the remote transmission of the *diagnostic* and *statistical* information to the outside of the home environment; in this event, the access to the remote site H of the service and preventive maintenance center could also be advantageously possible through Internet.

CLAIMS

1. System for monitoring a plurality of electric users (C), in particular household appliances, belonging to a same household environment and connected to a network (R), said electric users (C) comprising each one an electronic control system with interface means to said network (R), each electronic control means being programmed to send onto

5   said network (R), through said interface means, information related to operating conditions of the relevant electric user (C), characterized in that a monitoring device (F) connected to said network (R) is provided, which comprises first means (N,l,MP) for selecting and picking up data available on said network (R) and second means (MP,V,K,L,M) for organizing and making explicit to the outside the data selected and picked up from said

10   network (R).

2. System, according to claim 1, characterized in that said monitoring device (F) comprises memory means for storing the data selected and picked up from said network (R) and that said second means (MP,V,K,L,M) are apt to manage the making explicit of the data stored in said memory means (ME).

15   3. System, according to claim 2, characterized in that said first and/or second means (MP,V,K,L,M) comprise a microcontroller (MP).

4. System, according to claim 2, characterized in that said memory means (ME) are of the nonvolatile type, but updatable.

5. System, according to claim 1, characterized in that said second means

20   (MP,V,K,L,M) comprise a display device (V) to make said information explicit at local level, directly to the utilizer.

6. System, according to claim 1 or 2, characterized in that said second means (MP,V,K,L,M) are apt to manage and make said data explicit at a level being remote with respect said monitoring device (F).

25   7. System, according to claim 6, characterized in that said second means (MP,V,K,L,M) are apt to manage and make said data explicit at a remote level outside the household environment, for instance to a special customer service and maintenance center

(H) for said plurality of electric users (C).

8. System, according to claim 5 or 6, characterized in that said second means (MP,V,K,L,M) comprise interaction means (K) for selecting the type of data to be made explicit at local level and/or remote level.

9. System, according to claim 5 or 6, characterized in that said second means (MP,V,K,L,M) comprise interaction means (K) for activating and revealing or transmitting said data at a remote level.

10. System, according to claim 7, characterized in that said second means (MP,V,K,L,M) comprise a modem apt to be connected to a telephone line through an appropriate connection system (L).

11. System, according to claim 7, characterized in that said second means (MP,V,K,L,M) are apt to manage and make explicit or transmit said data at remote level through the Internet communication network, for sending said information to a remote site.

12. System, according to claim 7, characterized in that said second means (MP,V,K,L,M) are apt to make explicit or transmit said data at remote level outside said household environment through a telephone, in particular a cordless or mobile telephone (T), which is interfaced with said monitoring device (F) through an appropriate connection systems (M).

13. System, according to at least one of the previous claims, characterized in that said data are of a first type, concerning the current operation mode of each of said electric users (C), such operation mode being expressed through the value of a set of parameters and/or physical values characterizing the operation status of each user (C).

14. System, according to at least one of the previous claims, characterized in that said data are of a second type, concerning the operation quality of each of said electric users (C), said operation quality being expressed through the value of a set of diagnostic parameters typical of each user (C).

15. System, according to at least one of the previous claims, characterized in that said data are of a third type, concerning the operation statistical data of each of said electric

users (C), said operation statistical data forming in particular the history of each user from the viewpoint of the performed operations and/or functions, from the viewpoint of the usage procedure by the utilizer and revealing the wear status of determined components related to each of said electric users (C).

16. System, according to claim 8 or 9, characterized in that said interaction means (K) allow for the selection of the type of data to be transmitted or made explicit at remote level outside said household environment, the mode for their transmission and the relevant time interval.

17. System, according to claim 1, characterized in that said network (R) is connected to a source of information (A,B) on the total absorption of electric power in the household environment and on the value of the contractual power, i.e. the maximum electric power which can be used, based on a power supply contract, said source of information consisting in particular of a power meter (A) of said household environment or of an appropriate measuring device (B) located downstream a power meter (A) of said household environment.

18. System, according to claim 1, characterized in that said network (R) consists of the same electric supply network of the household environment and that said information are sent to said network (R) with the conveyed-waves technique, in particular with FSK (Frequency Shift Keying) or AFK (Amplitude Shift Keying) modulation, the flow of said information being ruled by appropriate protocols apt to warrant a non conflictual sharing of said network (R) among said electric users (C) in relationship with said monitoring device (F), and other likely users available in said household environment.

19. System, according to claim 1, characterized in that said electric users (C) are represented by the users of a kitchen environment consisting of the totality or a part of the following household appliances: refrigerator (C2), freezer (C5), dishwasher (C2), oven (C1), cooking hob (C6), exhaust hood (C7), laundry washer (C4), boiler.

20. System, according to claim 1, characterized in that at least a part of said household appliances (C1,C2,C3,C4,C5,C6,C7) are of the built-in type, i.e. incorporated in,

or associated with, pieces of furniture of a kitchen environment.

21. System, according to claim 1 or 20, characterized in that said network, to which said electric users or built-in household appliances (Cl,C2,C3,C4,C5,C6,C7) and said monitoring device (F) are connected, consists of a cable with at least two wires, that the communication between said appliances (C1,C2,C3,C4,C5,C6,C7) and said monitoring device (F) is of the serial type and that the communication system of said information is of the multi-point type managed by an appropriate protocol.

22. System, according to claim 21, characterized in that

- an information source (A,B) is provided, apt to admit to the electric supply network (R) of the household environment information related to a total absorption of electric power of the whole household environment and to the value of the power supply contract, i.e. the maximum electric power which can be used according to a supply contract,

- said monitoring device (F) is connected to said electric supply network (R) and is apt to constantly inform through said cable with at least two wires the control systems of said electric users or household appliances (C), of the value of the residual power available, obtained as a difference between the value of the power supply contract and the total absorbed power.

23. System, according to claim 17 or 22, characterized in that the electronic control system of each of said electric users or household appliances (C) is programmed to self-limit its own absorption of electric power, according to the difference between the value of the contractual power and the total absorbed power and according to appropriate priority criteria encoded in said control systems, with the aim that the value of the total power absorbed by the whole household environment will not exceed the value of the power supply contract, in particular to constantly avoid in an automatic manner any black-outs due to accidental power overabsorptions.

24. Device for monitoring a plurality of household appliances (C) belonging to a same household environment and connected to a network (R), where each of said appliances (C) comprises an electronic control system, said electronic control system of

each appliance (C) being programmed to make available on said network (R) information

relating to the operating conditions of the relevant appliance (C), said monitoring device

being characterized in that it comprises:

- interface means (I) to said network (R);

5   - means for selecting (K,MP) and picking up (N) data available on said network (R);

- means (MP,K) for organizing and eventually storing (ME) the data selected and picked

up from said network (R);

- means to manage the making explicit (MP,V,L,M,R) of the data selected, picked up and

eventually stored.

10   25. Device, according to claim 24, characterized in that it is either movable or

portable, specifically apt to be carried to any place of the household environment where a

power socket is available.

26. Device, according to claim 24, characterized in that it is associated, as a fixed

element, with a set of electric users belonging to a homogeneous context of the household

15   environment.

27. Device, according to claim 26, characterized in that said homogeneous context

is represented by a kitchen environment.

28. Device, according to claim 27, characterized in that it is integrated in the kitchen

furniture and represents a typical element of such an environment, to be adapted to the style

20   of the kitchen itself and/or associated with the correspondent trade-mark of the furniture

supplier.

29. Device, according to at least one of the previous claims, characterized in that it

is self-installing, i.e. requiring no operation by the utilizer not even during installation.

30. Device, according to at least one of the previous claims, characterized in that it

25   comprises a buffer battery.

31. Method for monitoring a plurality of electric users (C), in particular household

appliances belonging to a same household environment and connected to a network (R),

where each of said electric users (C) comprises an electronic control system with interface

means to said network (R), and each electronic control system is programmed to make

available on said network (R) information relating to the operation conditions of the

relevant appliance (C), said monitoring method being characterized in that it provides for

the following steps:

5   - selecting and picking up, through a monitoring device (F), the data available on said

network (R), the monitoring device (F) being interfaced with said network (R);

- organizing, by means of said monitoring device (F), the data selected and picked up, and

their likely storing in suitable memory means (ME) contained in said device (F);

- making explicit, through said monitoring device (F), the data that have been selected,

10   picked up and eventually stored.

32. Method, according to claim 31, characterized in that said data are made explicit

at local level within the household environment.

33. Method, according to claim 31, characterized in that said data are made explicit

or transmitted at remote level, i.e. outside the household environment.

15   34. Method, according to claim 33, characterized in that said data are transmitted to

a service and/or preventive maintenance center (H) for said electric users (R).

35. Method, according to claim 31, characterized in that said data are of a first type,

concerning the current operating mode of each of said electric users (C), said operating

mode being expressed through the value of a set of parameters and/or physical quantities

20   characterizing the operation status of each users (C).

36. Method, according to claim 31, characterized in that said data are of a second

type, concerning operation quality of each of said electric users (C), said operation quality

being expressed through the value of a set of diagnostic parameters typical of each user (C).

37. Method, according to claim 31, characterized in that said data are of a third

25   type, concerning statistical information of operation of each of said electric users (C), said

operation statistical data forming in particular the history of each user both from a

viewpoint of the performed operations and/or functions and the viewpoint of usage

procedures by the user, and revealing the wear status of determined components related to

each of said electric users (C).

38. Method, according to at least one of the previous claims, characterized in that the selection is provided of the type of data to be made explicit at local level and/or remote level.

39. Method, according to at least one of the previous claims, characterized in that the selection is provided of the transmission procedure for said data at remote level and their relevant time interval.

40. Method, according to claims 34 and 36, characterized in that the service activity of said center (H) is based on said data of the second type.

41. Method, according to claims 34 and 37, characterized in that preventive maintenance activity of said center (H) is based at least on said data of the third type.

42. Method, according to claims 36 and/or 37, characterized in that the transmission at remote level of said data to said center (H) occurs either through a manual instruction or in automatic manner.

43. Method, according to the previous claim, characterized in that the transmission of said information to said center (H) is performed by the user through a direct phone call to a correspondent toll-free number.

44. Method, according to claims 36 and/or 37, characterized in that the control systems of said electric users (C) generate said data of the second type and/or said data of the third type, store them in their own memory means and update them in the time.

45. Method, according to claim 44, characterized in that the control systems of said electric users (C) periodically make available on said network (R) the stored data of the second type and/or of the third type.

46. Method, according to claim 45, characterized in that said monitoring device (F) picks up from said network (R) said data of the second type and/or the third type, store them in its own nonvolatile memory means and transmit said stored data at a remote level.
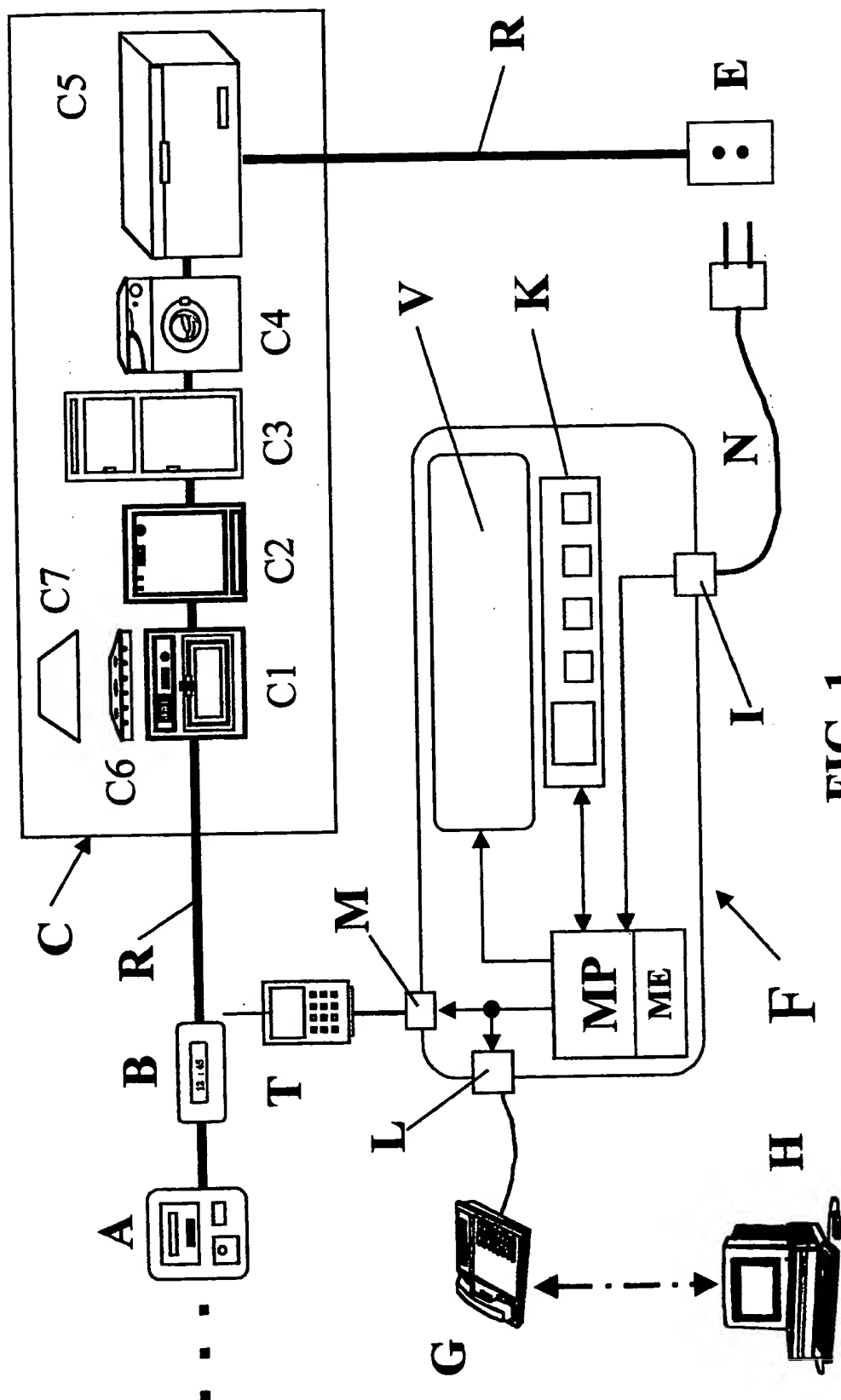
FIG. 1

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6   H02J13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6   H02J   G05B   G05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 727 668 A (MERLONI ELETTRODOMESTICI SPA) 21 August 1996 cited in the application see the whole document	1-46
A	US 4 602 340 A (APPELBERG GUSTAF T) 22 July 1986 see the whole document	1-46
A	EP 0 727 860 A (BOSCH SIEMENS HAUSGERAETE) 21 August 1996 see abstract	1-6,13, 24-26, 31,32
A	EP 0 040 689 A (MICROTEC ELECTRONIC GMBH) 2 December 1981 see the whole document	1,24-26, 31

-/-

| X | Further documents are listed in the continuation of box C. | X | Patent family members are listed in annex. |

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 May 1999	07/06/1999

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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US 4644320	A	17-02-1987	NONE		